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Continental Great Spotted Woodpeckers *Dendrocopos major* in Britain – further analyses of wing-length data

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Recent studies have suggested that the wing lengths of British Great Spotted Woodpeckers *Dendrocopos major anglicus* are more variable than originally thought and raised questions about the occurrence of continental races of Great Spotted Woodpeckers in Britain. In this study, wing-length data from the British Trust for Ornithology database were used to explore in more detail the patterns of occurrence of long-winged birds. Because of the larger sample size, the range (122–141 mm) is bigger than that quoted in standard texts and overlaps that for the nominate continental race *D. m. major* and also *D. m. pinetorum*. Only in extreme cases is it possible to determine the race of an individual bird on wing length alone, although patterns of occurrence of long-winged birds are informative. There was an excess of long-winged birds (>139 mm) trapped at all east-coast sites, particularly in Scotland and in the irruption year of 2001/02. In non-irruption years, there was an excess of long-winged birds at east-coast sites in Scotland but not elsewhere. The origin of these long-winged birds is still unclear but is most likely to involve birds from Scandinavia. Measurements of other characters, such as bill length and depth, may throw more light on this and help decide whether distinct subspecies exist, rather than there being a cline from western Europe through Scandinavia to Siberia.

In their recent paper, Coulson & Odin (2007) used wing-length data collected by bird ringers operating under the UK ringing scheme administered by the British Trust for Ornithology (BTO) to examine the evidence for the regular occurrence of continental Great Spotted Woodpeckers *Dendrocopos major* in mainland Britain. A number of subspecies of Great Spotted Woodpecker have been suggested but three are particularly relevant to Britain; the nominate subspecies *D. m. major* from Russia and Scandinavia, *D. m. pinetorum* from northern Europe and the near continent and *D. m. anglicus* in Britain. *D. m. major* has a longer mean wing length than the British subspecies *anglicus* (Cramp 1985, Baker 1993) and it was suggested that individuals of the two could be distinguished on the basis of wing length, although this has subsequently been questioned (Odin 2006). *Anglicus* also differs from nominate *major* in its smaller overall size, longer more slender bill and darker plumage (Hartert 1907, Cramp 1985, Baker 1993). *Anglicus* and *pinetorum* have very similar wing length and are probably indistinguishable on this character. Hartert (1907) and, more recently, Winkler *et al* (1995) have even questioned the distinctness of these subspecies and suggested the differences may simply represent a cline.

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Although there are other characters such as bill shape and plumage that can potentially be used to differentiate *major* and *anglicus*, most recent attention has focused on wing length, probably because it is routinely measured by ringers and substantial data sets are therefore available. Coulson & Odin (2007) concluded that the wing lengths of *anglicus* are more variable than originally thought, making the identification to subspecies using wing length alone unreliable. They found an excess of long-winged birds in the BTO database but questioned the suggestion in the *Migration Atlas* (Smith 2002) that continental Great Spotted Woodpeckers occur in Britain in most years.

In this paper I use the same BTO data set as used by Coulson & Odin (2007) with the addition of data covering 2006, 2007 and part of 2008 and carry out additional analyses to explore in more detail the patterns of occurrence of long-winged birds and discuss the implications of these patterns.

METHODS

If they reach Britain, it would be expected that continental Great Spotted Woodpeckers would be more likely to be found at east-coast sites than elsewhere. Coulson & Odin

(2007) divided their data into east-coast sites and others on the basis of the location of the county of the trapping site. However, many coastal counties, particularly some of the larger ones, extend well inland so, in this new analysis, I have used a Geographic Information System (MapInfo version 6.0, 2000) and the 1-km grid reference of the trapping site to categorise sites as those within 10 km of the coast and those further inland. In addition I have categorised coastal sites as those on the east coast (from Kent to Shetland) and others (south and west coasts). Country (in essence England and Scotland) has been used in some analyses as a categorical variable. There is a statistically significant difference in wing lengths of males and females (difference in mean wing length = 0.48 mm, $t = 2.71$, $P = 0.007$) but this is small compared with the racial differences considered in this paper. So, following Coulson & Odin (2007), data from the two sexes have been combined in these analyses, although the numbers of long-winged birds were checked for any sexual bias.

To limit the potential for circularity, I used data from inland sites and for birds trapped only during the core of the breeding season (April and May) to characterise the basic wing-length distribution of breeding British Great Spotted Woodpeckers. Coulson & Odin (2007) excluded data from juvenile birds trapped before September because they could still be growing their primaries until then. However, for Great Spotted Woodpeckers, both adults and juveniles undergo a full primary moult immediately after the breeding season (Ginn & Melville 1983, Cramp 1985, Baker 1993) so in this analysis wing lengths of all birds measured in June, July and August have been excluded to limit the possibility of them being affected by active primary moult. For each bird, only the first wing-length measurement in the database has been included in the analyses.

Following Coulson & Odin (2007), I have used probability plots to look for departures from normality in wing length and then explored the relationships between the proportion of long-winged birds in the sample and geographic factors such as inland versus coastal sites and east coast versus south and west coast. The numbers of long-winged birds are small, so I have used binomial tests to determine whether the proportions are significantly different from those expected from the wing-length distribution of inland breeding birds. I have followed Coulson & Odin (2007) in defining a long-winged bird as one with a wing length >139 mm.

To test whether excess long-winged birds occur only in irruption years I have carried out an additional analysis using only the data collected since 1996, the first year when a substantial number of records were available (see results), and comparing the autumn and winter (September–May) of 2001/02 (a known irruption year; Forrester & Andrews 2007) with other years. In this way I have allowed for the possibility of long-winged birds arriving in the autumn and remaining in Britain until the following spring.

All statistical analyses were carried out in Minitab 15 (Minitab Ltd, Coventry, UK).

RESULTS

A total of 17,722 records of Great Spotted Woodpecker wing length were available on the BTO database. Removal of multiple retraps and birds measured in June–August left a total of 7,857 records for this analysis (5,504 for inland and 2,353 for coastal sites; 857 for inland sites in April/May). The majority of the records are for the period 1996 to 2008 when computerised data entry became widely used by British ringers. Although there are some records back to 1966, it was not until 1996 that the annual total rose above 100. Typically there are now 800–1,000 records per year which can be used in this analysis. So, in drawing conclusions from these analyses, it must be remembered that the majority of records cover only just over a decade from 1996 to 2008.

The cumulative probability plot for April/May records from inland sites is shown in Fig 1. This shows an extremely good match for a normal distribution except for an excess of short-winged birds (wing length 125 mm and less). Departure from normality is apparent when the data points lie outside the regression line and its confidence intervals. An excess of short-winged birds is indicated by the points lying above the line at short wing lengths. Conversely, an excess of long-winged birds is indicated when the points lie below the line for high wing lengths. The mean wing length

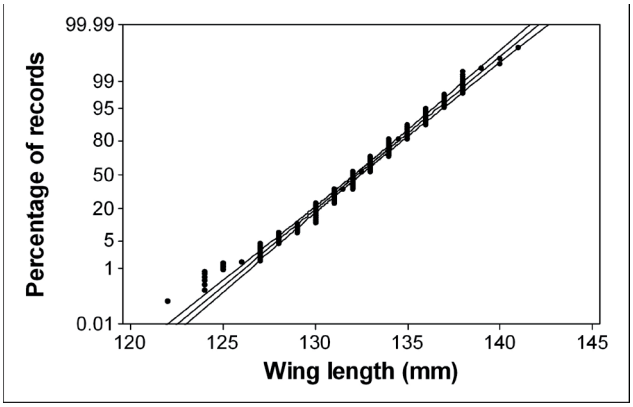

Figure 1. The cumulative probability plot for all birds measured at inland sites in April and May (n = 857). The fitted lines represent the expected normal distribution and 95% confidence intervals. This plot shows no evidence of an excess of long-winged birds over that expected for a normal distribution but a considerable excess of short-winged birds.

was 132.3 mm (SD = 2.6, range 122–141, n = 857, sexes combined). At first sight this appears to be longer than the mean of 130.2 mm (SD 2.6, range 126–134, n = 28, sexes combined) quoted for *anglicus* in *The Birds of the Western Palearctic* (BWP; Cramp 1985). However this ignores the fact that the BWP figures are based on measurements of museum skins, which are known to shrink a little during preparation, giving slightly shorter wing lengths compared with live specimens. Figures given in Svensson (1992) and references therein suggest a mean shrinkage of around 1.8% during skin preparation, implying that the BWP mean should be increased to 132.5 which is a very close match to the results from the BTO data.

The range of wing lengths for the live birds trapped inland in April/May is far wider than that given in BWP but this reflects the larger sample size rather than the parameters of the distribution. The numbers of birds with long wings match pretty well what would be expected from the parent distribution and sample size. There were three birds with wing length >139 mm (the threshold used by Coulson & Odin 2007 to define long-winged birds and also used in this paper) in this sample, very close to the 2.6 predicted for this normal distribution (binomial test, $P = 1.00$).

The cumulative probability plot for the full set of birds trapped at inland sites is shown in Fig 2. There is no evidence from the plots of an excess of long-winged birds and the numbers of long-winged birds are as expected from the basic breeding-season distribution. Twelve birds (from a sample of 5,504) had wing length >139 mm compared with 17.6 predicted from the basic wing-length distribution of British breeding birds (binomial test, $P = 0.191$).

Similarly, for south and west coastal sites the cumulative probability plot (Fig 3) shows little evidence of an excess of long-winged birds. Seven birds (from a sample of 963) had wing length >139 mm compared with a prediction of 3.1, which did not quite reach statistical significance (binomial test, $P = 0.083$).

For east-coast sites there was a significant excess of long-winged birds (Fig 4) with 24 (from a sample of 1,390 birds) with wing length >139 mm compared with 4.4 predicted from the British-breeding distribution (binomial test, $P < 0.001$). If the east-coast data are divided into English and Scottish sites, the results are even more striking. For England, 14 birds had long wing lengths (from a sample of 1,216) compared with a predicted 3.9 (binomial test, $P < 0.001$). In Scotland, however, ten birds from a sample of only 174 had long wing length compared with a predicted 0.6 (binomial test, $P < 0.001$). The proportion of long-winged birds was significantly higher in east-coast Scotland than east-coast England (comparison of binomial proportions, $z = 2.57$, $P = 0.010$).

There was no suggestion of one sex or the other being predominant amongst the long-winged birds. Of the 43 long-winged birds in the sample, 16 were male, 16 female and the rest unsexed. Long-winged birds occurred in all months analysed but with the highest numbers in September and October (13 in September, six in October, mean for other months 3.4, range 2–5).

Irruption years

In the irruption year of 2001/02, 14 birds from a sample of 126 trapped at east-coast sites had wing length >139 mm, far in excess of the number expected for British breeding birds (binomial test, $P < 0.001$). Although the sample sizes were small, the proportion of long-winged birds at coastal sites in Scotland (five out of 22) was not significantly different from the proportion for sites in England (nine out of 104) (comparison of binomial proportions, $z = 1.51$, $P = 0.132$).

For non-irruption years since 1996, eight birds from a sample of 1,159 trapped at east-coast sites had wing length >139 mm which was not significantly higher than

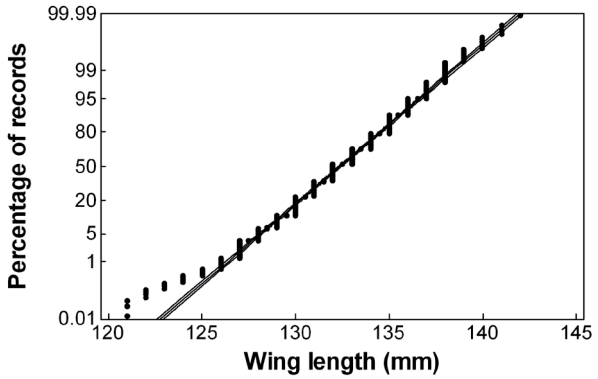

Figure 2. The cumulative probability plot for all birds measured at inland sites throughout the year (n = 5,504). There is no evidence of an excess of long-winged birds over that expected for a normal distribution but there are many short-winged birds.

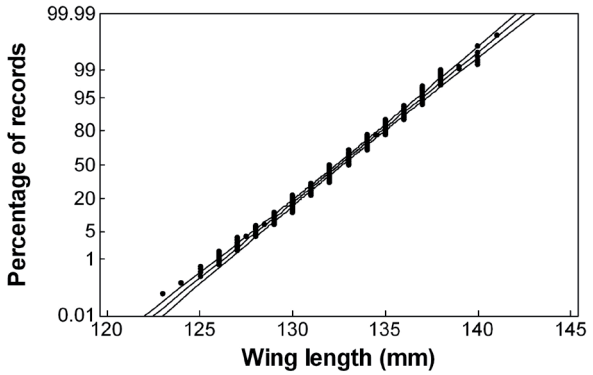

Figure 3. The cumulative probability plot for all birds measured at west- and south-coast sites (n = 963). There is no evidence of an excess of long-winged birds in this distribution.

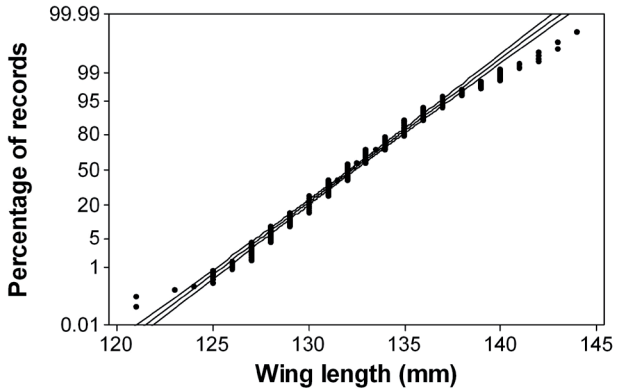

Figure 4. The cumulative probability plot for all birds measured at east-coast sites (n = 1,390). There are clear excesses of both long- and short-winged birds compared with the expected numbers for a normal distribution.

the number expected for British breeding birds (binomial test, $P < 0.060$). However in east-coast Scotland there were four long-winged birds in a sample of 148, well in excess of the number expected for British breeding birds (binomial test, $P = 0.001$). This suggests an excess of long-winged birds in Scotland, even in non-irruption years, but not in England.

DISCUSSION

When allowance is made for the shrinkage of museum specimens, the wing-length distribution of British breeding birds agrees very well with that given in BWP (Cramp 1985) but, being based on a small sample, the range quoted in BWP is smaller than seen in a large sample. These results confirm the conclusion of Coulson & Odin (2007) that, except in extreme cases, it cannot be assumed that individual long-winged birds are of continental origin; even with a threshold of >139 mm, there is a small but finite chance that they could be *anglicus*. However the patterns of occurrence of long-winged birds are consistent with some at least being of continental origin.

There was a clear excess of long-winged birds trapped on the east coast and particularly in Scotland where, overall, 5% of birds had wing length >139 mm. In the irruption year of 2001/02, 22% of birds measured at east-coast Scottish sites had wing length >139 mm. Although based on a small sample, in Scotland there was an excess of long-winged birds even in non-irruption years, but this was not the case in England.

The selection of coastal sites in this analysis on the basis of distance from the coast (< 10 km) rather than coastal county has served to allow a better focus on the long-winged birds, particularly in England. For all birds in England (n = 7,264), 0.34% had wing length >139 mm but for eastern coastal counties (n = 2,547) this rose to 0.63% and for sites within 10 km of the east coast (n = 1,216) this was 1.15%. In Scotland the fraction of long-winged birds was generally higher and showed less of a coastal influence. For the whole of Scotland (n = 386), 4.15% had wing length >139 mm, which rose to 5.75% from n = 174 for sites within 10 km of the east coast.

The origin of these long-winged birds is a matter of conjecture. Michalek & Miettinen (2003) compiled published data on Great Spotted Woodpecker wing lengths from throughout Europe. These data are reproduced in Table 1 but with two additions; wing lengths converted to expected values for live specimens based on 1.8% shrinkage for museum specimens and the expected range based on ± 3 standard deviations. For small samples, this is a more reliable indicator of the expected range than the measured range. Using the 3 SD range means there is only one chance in a thousand of a bird from that population having a wing length outside this range. There is clearly a big overlap of expected wing lengths between *anglicus* and the other subspecies, except for nominate *major* from western Siberia. Even for *major* there is a cline in wing length, with birds from Scandinavia having the shortest wings. The long-winged birds in this sample had wing lengths in the range 140–144 mm, which is consistent with them originating from the near continent or Scandinavia. For *pinetorum* in France and the Netherlands and *major* in Scandinavia, the expected wing-length ranges are 130–144 mm, 129–144 mm and 137–149 mm respectively. Given the preponderance of long-winged birds in Scotland, the most likely source is Scandinavia.

There have now been three recoveries of Great Spotted Woodpeckers involving overseas movement. A bird ringed at Dungeness in September 1962 and recovered in Belgium later the same year had wing length of 137 mm (David Walker pers. comm.) – long for *anglicus* but well within the possible range. 1962 was an irruption year and two other Great Spotted Woodpeckers ringed at Dungeness in September 1962 with wing lengths of 139 mm and 140.5 mm were identified at the time as *major* (David Walker pers. comm.). Two birds ringed in Norway have been recovered in Britain. A male ringed in September 2001 (an irruption year) was found long dead in Shetland in 2003 (Clark *et al* 2004) and a male ringed in April 2005 was found in Shetland in May the same year (Clark *et al* 2007). Unfortunately, wing lengths are not available for either of these birds. These recoveries add credence to the suggestion of a Scandinavian origin for the long-winged birds.

The occurrence of excess short-winged birds in virtually all of the samples deserves comment. The subspecies *anglicus* is one of the shortest-winged of all (Cramp 1985)

Table 1. Summary of the wing lengths of Great Spotted Woodpeckers from Russia and northwest Europe. The corrected mean is the mean wing length for live specimens calculated assuming museum skins are subject to 1.8% wing-length shrinkage (Svensson 1992). The estimated range is calculated as ± 3 standard deviations from the mean.

Country	Subspecies	Sex	Mean	SD	Quoted range	Sample n	Corrected mean	Estimated range ± 3 SD	Reference
W Siberia	*major*	both	142.2	1.6	140–145	8	144.8	140–150	Cramp 1985
Russia	"	male	141.8	2.0	137–146	61	144.3	138–150	Ivanchev 1994
"	"	female	142.3	2.4	137–149	62	144.9	138–152	"
European USSR	"	both	142.3	2.6	138–147	12	144.9	137–153	Cramp 1985
Scandinavia	"	both	140.7	2.1	138–146	15	143.2	137–149	"
Belarus	*major/pinetorum*	male	140.6	4.9	136–144	31	143.1	–	Alex 1994
"	"	female	140.5	2.4	136–145	20	143.0	136–150	"
Poland	*pinetorum*	both	137.6	3.2	134–145	10	140.1	131–150	Cramp 1985
Germany	"	both	134.9	2.7	129–141	23	137.3	129–145	"
"	"	male	137.9	2.5	133–147	34	140.4	133–148	Schönfeld 1997
"	"	female	136.5	2.6	129–142	51	139.0	132–147	"
"	"	male	136.7	2.5	–	13	139.2	132–147	Eck 1983
"	"	female	136.9	2.1	–	31	139.4	133–144	"
Netherlands	"	both	134.0	2.4	128–138	32	136.4	129–144	Cramp 1985
France	"	both	134.6	2.3	130–139	19	137.0	130–144	"
Austria	"	male	132.8	2.5	128–138	34	135.2	128–143	Michalek &
"	"	female	132.7	2.4	129–138	31	135.1	128–143	Miettinen 2003
Britain	*anglicus*	both	130.2	2.6	126–134	28	132.5	125–140	Cramp 1985

so it is unlikely that another subspecies is involved. It is possible that the short-winged birds are an artefact. IPMR (Integrated Population Monitoring Reporter), the computer package used to collect ringing data in Britain and Ireland, has in-built ranges to check that wing lengths are reasonable. For Great Spotted Woodpecker anything above 138 mm has required the person entering the data to confirm the value whereas a minimum of 120 mm has been allowed without comment. Hence the long-winged birds in the sample are likely to be genuine in that the person entering the data, when challenged by the system, has confirmed the wing length. On the other hand, very short wing lengths (120–125 mm), which could be the result of measurement or data-entry errors or birds with damaged or re-growing primary feathers, are accepted by the system without comment.

McGowan in *The Birds of Scotland* (Forrester & Andrews 2007) shows regular records of presumed northern Great Spotted Woodpecker in Shetland and Fair Isle. In the 35 years between 1970 and 2004 there were 11 with significant numbers, the highest being in 2001. There are other records from Orkney, Isle of May and a few mainland sites. Examination of the BTO wing-length data shows that long-winged birds are by no means restricted to the islands. Of the 16 birds trapped in Scotland with winglength >139 mm, three were in the Northern Isles, four from the Isle of May and nine on the mainland.

Given that, except in extreme cases, wing length is unable to distinguish the races with certainty, what can be done to allow their identification? Ultimately, chemical, isotopic or genetic techniques (Coiffait *et al* 2009) may prove to be reliable but as yet these are not readily available to ringers. Hartert (1907) describes differences in bill shape as a key distinguishing feature. There is an overlap on bill length but bill depth does seem a possible distinguishing feature, with *anglicus* having a long narrow bill. Unfortunately there are not enough measurements within the BTO data set to allow a thorough analysis of these two characters. There are only 87 bill-length and 22 bill-depth measurements in the database and furthermore three different measurement methods (at the gonys, feathers and nostril; Redfern & Clark 2001) have been used for the bill depth. I would urge ringers to start recording bill dimensions of Great Spotted Woodpeckers using standard methods so that within a few years sufficient data will be available to determine if bill shape is a better feature than wing length or whether it too is confounded by overlaps between the races. Bill length is probably best measured to the skull and, following the recommendation in the *Ringers' Manual* (Redfern & Clark 2001), bill depth at the distal edge of the nostril.

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